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Five New Species of Skates in the Genus *Bathyraja* from the Western North Pacific, with Reference to Their Interspecific Relationships

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Abstract Five new species of skates, *Bathyraja caeluronigricans*, *B. notoroensis*, *B. maculata*, *B. lindbergi*, and *B. minispinosa* were described from the western North Pacific. *Bathyraja matsubarai* (Ishiyama, 1952) was revised and redescribed, not only because this species is closely related to the above species but because one of the paratypes of this species was newly erected as *B. notoroensis*. Relationships of the six species were discussed morphologically and zoogeographically.

Introduction

The skates, family Rajidae, occur world-wide in shallow to deep seas across the temperate and subpolar zones. This family is one of the largest groups of the order Rajiformes in number of species as well as in geographic range.

The family Rajidae was divided into six genera, *Dactylobatus*, *Raja*, *Cruriraja*, *Breviraja*, *Psammobatis*, *and Sympterygia* by Bigelow & Schroeder (1948). Later, the genus *Rhinoraja* was added to the family by Ishiyama (1952).

In 1968, the genus *Bathyraja* was proposed by Ishiyama and Hubbs for the skates which are allied to *Breviraja* but distinct from it in the structure of the rostral cartilage and the clasper. The center of distribution of *Bathyraja* is the North Pacific; 11 species have been recorded from the western part of the region by many authors. The range of the genus has recently been extended to the eastern North Atlantic (Stehmann, 1970), South Africa (Hulley, 1970), Antarctica (Springer, 1971), and New Zealand (Garrick and Paul, 1974).

Recent investigations of the western North Pacific by the Tokyo University of Fisheries and Fisheries Agency, Japan, yielded sizable collections of skates, in which a number of

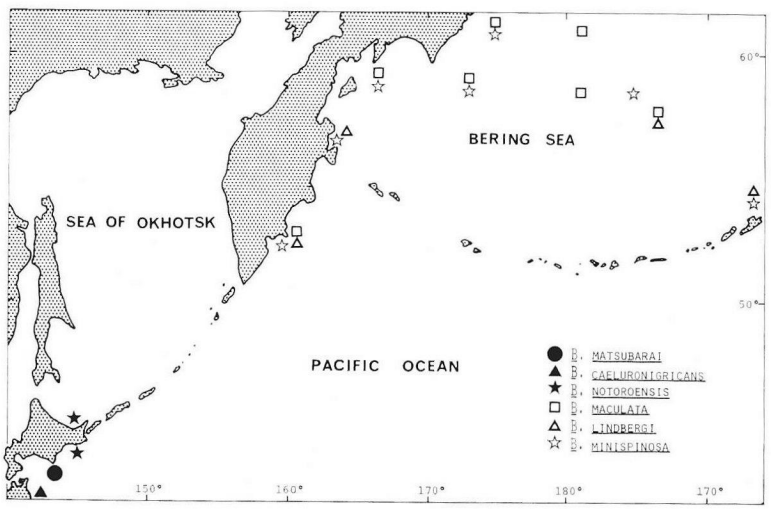

Fig. 1. Map of the western North Pacific showing collecting localities for the six species of *Bathyraja*.

specimens with unusual characters were contained. Subsequent study has revealed that these unusual specimens represent five undescribed species, though they are closely related to *Bathyraja matsubarai*, which was originally described as *Breviraja matsubarai* by Ishiyama (1952) from Hokkaido.

In this paper the western North Pacific refers to the area from Kyushu north to the Bering Sea and east to 160°W, and whole part of the Sea of Okhotsk and the Sea of Japan (Fig. 1).

Methods

Counts and measurements were generally made according to the methods proposed by Hubbs and Ishiyama (1968). Those which were not adopted in their work but employed in the present study were the number of pseudobranchial folds in the spiracles (Fig. 2), length of the electric organs, and proportions of the parts of the clasper (Fig. 3, A). Counts and measurements for bilateral parts, when different, were averaged. The nomenclature of the parts of the clasper and of the cartilage used in the present study were mainly in accordance with that of Leigh-Sharpe (1920～1926), Ishiyama (1958b), Stehmann (1970), and Hulley (1972), and that of the egg capsule followed Ishiyama (1958a). The methods of measurements of the egg capsule are shown in Fig. 4. Young specimens were used only for counting characters.

Vertebral counts were taken from radiographs. Proportional measurements for the cranium were made on adult and immature specimens. Coloration was observed on both fresh-caught and formalin specimens.

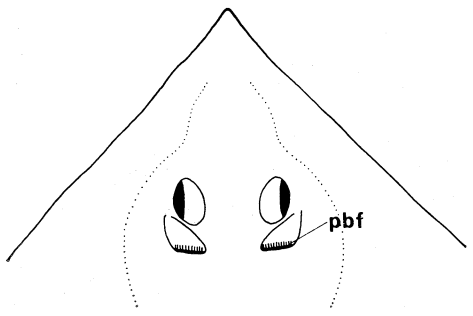

Fig. 2. General structure of the orbital region in *Bathyraja*. pbf, pseudobranchial folds.

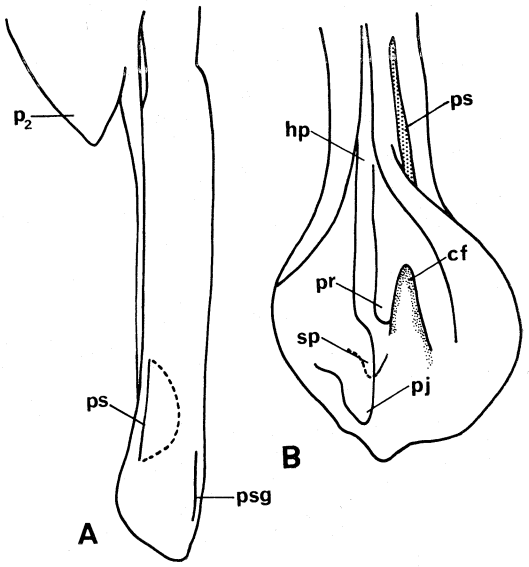

Fig. 3. General structure of clasper (left-side) in *Bathyraja*. A, clasper groove closed. B, clasper groove opened. cf, cleft; hp, hypopyle; p_2, pelvic fin; pj, projection; pr, pseudorhipidion; ps, pseudosiphon; psg, pseudosiphon-like groove; sp, spur.

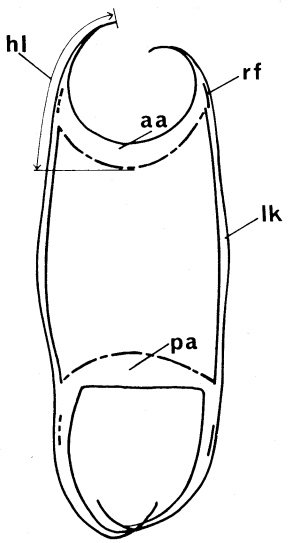

Fig. 4. General shape, structure, and measurement of egg capsule in *Bathyraja*. aa, anterior apron; hl, horn length; lk, lateral keel; pa, posterior apron; rf, respiratory fissure.

Descriptions

Genus *Bathyraja* Ishiyama and Hubbs, 1968

Breviraja Ishiyama (not Bigelow & Schroeder, 1948), 1952: 7.

Bathyraja Ishiyama and Hubbs, 1968: 407 (type species: *Raja isotrachys* Günther, 1887).

Diagnosis. Snout soft and flexible. Dorsal side of disk and tail with prickles and large spines in most species. Malar hooks not developed in both sexes but alar hooks well developed in male. Tail as long as or longer than disk length. Rostral cartilage weak and rod-like, extending to tip of snout; its basal part without segment. Rostral appendix fused basally with anterior part of rostral cartilage, its anterior margin with a shallow notch on each side, posterior portions hanging backward free from rostral cartilage. Tip of radial cartilages of pectoral fins close to lateral sides of rostral appendix (Fig. 5).

Clasper cylindrical, simple in structure, without shield and rhipidion (Fig. 3, B). Pseudosiphon present or not. Egg capsule rectangular, usually about 7 cm or more in long axis excluding horns, middle part more or less swollen. The capsule consisting of two layers, outer thick layer with densely distributed minute prickles; whip-like horn on each of the four corners of capsule; posterior horns longer than anterior ones; respiratory fissures in middle or distal portions of horns, but not on their tips (Fig. 4). Caudal vertebrae 60～91 from 1st caudal vertebra to origin of 1st dorsal fin. Electric organs made up of cup-form elements, situated in posterior half of tail.

Bathyraja matsubarai (Ishiyama)
(Japanese name: Matsubara-ei)
Fig. 6

Breviraja matsubarai Ishiyama, 1952: 10 (in part).

Holotype: FAKU (Faculty of Agriculture,

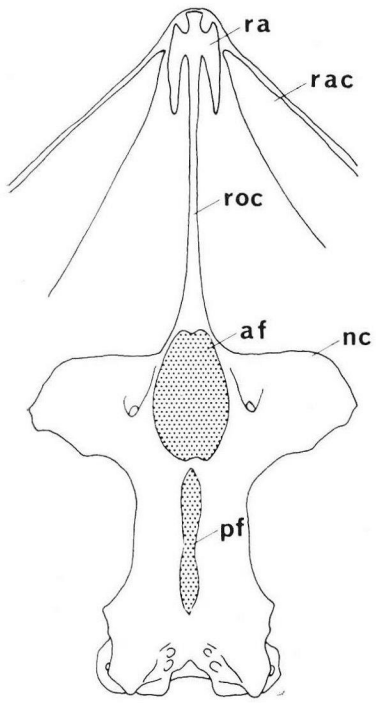

Fig. 5. Structure of cranium of *Bathyraja* (dorsal view, snout top). af, anterior fontanelle; nc, nasal capsule; pf, posterior fontanelle; ra, rostral appendix; rac, radial cartilage; roc, rostral cartilage.

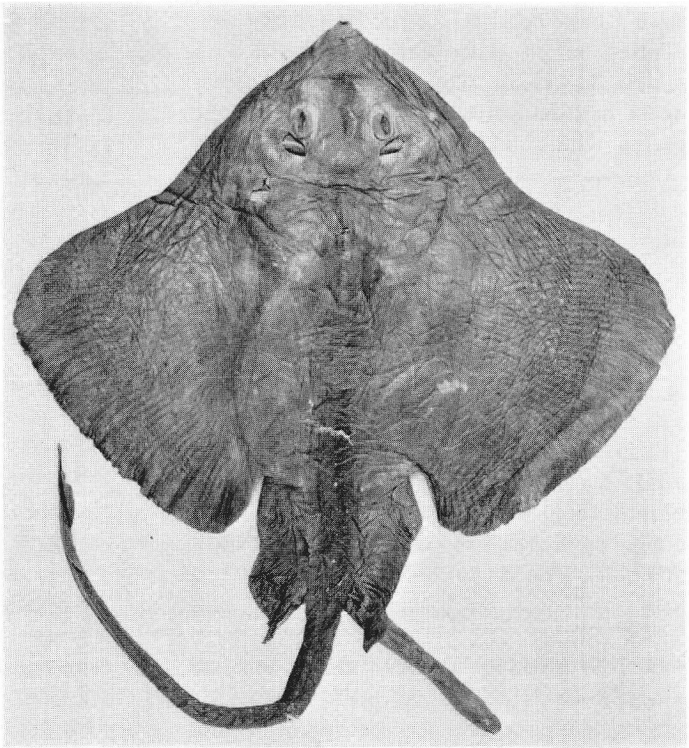

Fig. 6. *Bathyraja matsubarai*, holotype, FAKU 49458, male, 633 mm in disk width.

Kyoto University) 49458 (Ishiyama's Fish Collection No. 16701), adult male, 633 mm in disk width, collected off Erimo Peninsula (41°30′N, 143°15′E), Hokkaido, at a depth of about 800 m, on May 20, 1951.

Paratype: MTUF (Museum, Tokyo University of Fisheries) 21832, 1 young male, 447 mm, captured with the holotype.

Seventeen specimens were designated as paratypes in the original description of this species, but no catalogue number were given. In Ishiyama's personal list of specimens, his personal catalogue numbers, data on their size, and collecting localities are given. Of these one has been deposited in FAKU and six in MTUF. Other 10 paratypes were not available for this study. Five of the six MTUF specimens are of very young stage (less than 150 mm in disk width) and therefore of ambiguous specific identity. The remaining one specimen proved to be *B. matsubarai* and newly given catalogue number MTUF 21832 as indicated above. The single FAKU specimen, which was collected by K. Matsubara at Akkeshi Fish Market, Hokkaido, was identified as *B. notoroensis* and designated as a paratype of the species, with catalogue No. FAKU 49459.

Diagnosis. *Bathyraja matsubarai* differs from other species of the genus *Bathyraja* in the combination of dark purplish brown both sides of body, eyeball as long as spiracle length, smooth interorbital space, and clasper with a deep cleft.

Description. Meristic counts and morphometric measurements of the holotype and paratype are shown in Table 1.

External features: Snout short, soft and broad; eyeball as long as spiracle; interorbital space flat and wide. Two dorsals large, equal in size, separated from each other by a short interspace. Tail longer than precaudal. Lateral folds developed on posterior half of tail. Dorsal side of disk rough with both large spines and prickles; scapular and interdorsal spines absent. A row of mid-dorsal spines running from before scapular arch to first dorsal; the row interrupted at middle of trunk. Lumbar spines, when present, followed by tail spines. Prickles developed on dorsal surface of disk, posterior pelvic lobes, two dorsals and caudal, and absent at interorbital space, in central part of pectorals, on tip of snout and anterior pelvic lobes. Ventral side of body smooth. Skin covering eyes without prickles.

Coloration: Ground color of dorsal side dark purplish brown, ventral side lighter. Areas in front of mouth, immediately before gill slits and around cloaca, distal portion of anterior pelvic lobes, and sensory pores whitish.

Internal features: Cranium wide; rostral cartilage short, soft, poorly calcified, slightly undulated; rostral appendix elongate, extending to middle of rostral cartilage; anterior fontanelle oval-shaped, posterior margin flat, anterior margin extending to the line connecting front edge of nasal capsules; posterior fontanelle long, with a constriction in the middle (Fig. 7, A).

Clasper: Clasper long, extending to middle of tail, cylindrical, with a round tip; pseudosiphon large, located far from tip of clasper. Inner surface of dorsal lobe with a deep cleft and a pseudorhipidion. Posterior portion of inner surface of ventral lobe with a large projection and a small spur. Axial cartilage spatulated distally. Three dorsal terminals (**1**～**3**) more or less well developed. Dorsal terminal 1 elongate, pointed at anterior and posterior ends, middle portion swollen. Ventral terminal narrow anteriorly, gradually broadened toward posterior end like the leaf of ginkgo. Accessory terminal small, firmly connected to posterior edge of ventral marginal (Fig. 8, A).

Bathyraja caeluronigricans sp. nov.
(New Japanese name: Tsumura-kasube)
Figs. 9, A and B

Holotype: MTUF 21803, adult male, 744 mm in disk width, collected off Hachinohe (41°00′N, 142°00′E), at a depth from 200～400 m, on Oct. 23～26, 1975.

Paratypes: 2 adult males, MTUF 21804, 728 mm, MTUF 21805, 696 mm; 4 adult females, MTUF 21806, 722 mm, MTUF 21807, 700 mm, MTUF 21808, 677 mm, MTUF 21809, 674 mm; 4 young males, MTUF 21810, 579 mm, MTUF 21811, 484 mm, MTUF 21812, 458 mm, MTUF 21813, 445 mm; 3 young females, MTUF 21814, 600 mm, MTUF 21815, 386 mm, MTUF 21816, 377 mm; all the

Table 1. Counts and measurements of two species of *Bathyraja*. —, not examined; *, number of vertebrae counted up to the origin of second dorsal; **, from three specimens.

Characters	*B. matsubarai*			*B. caeluronigricans*		
	Holotype	Paratype N=1 (young 1)	Mean N=2	Holotype	Paratypes N=13(♂2, ♀4, young 7)	Mean N=14
1. Total length (mm.)	1037	—		1206	1104~1231	1172.7
2. Disk width (mm.)	633	—		744	674~744	705.9
3. Head length (mm.)	160	—		191	188~199	193.6
4. Tail length (mm.)	558	—		649	569~657	620.6
5. Precaudal vertebrae	38	36	37.0	36	36~38	36.6
6. Caudal vertebrae	72	72	72.0	73	69~75	71.9
7. Total vertebrae*	120	120	120.0	122	119~124	121.2
8. Nuchal spine	4	3	3.5	3	2~5	3.0
9. Lumbar spine	0	1	0.5	2	0~2	0.4
10. Tail spine	30	22	26.0	31	26~35	29.9
11. Alar hooks in longitudinal	23.5	—		22	21~23	22.0
12. Alar hooks in transverse	7.5	—		6	6~7	6.3
13. Spiral valves of the intestine	—	11		—	9~11	10.0
14. Tooth rows on upper jaw	25	21	23.0	29	25~30	27.1
15. Pseudobranchial folds	16	18	17.0	19	17~19.5	18.2
In % of disk width						
16. Total length	163.8	—		162.1	158.6~174.4	166.3
17. Disk length	79.0	—		79.3	80.4~85.5	82.3
18. Tail length	88.2	—		87.2	81.8~94.1	88.0
In % of head length						
19. Preocular length	54.6	—		64.9	61.4~66.0	64.2
20. Interorbital length	27.7	—		26.2	24.1~27.2	25.4
21. Eyeball length	18.2	—		14.4	12.5~15.4	14.1
22. Spiracle length	19.2	—		19.9	17.2~20.1	18.5
23. Over 1st gill slits (male)	127.0	—		123.6	117.5~128.5	123.2
24. Over 1st gill slits (female)	—	—		—	119.6~132.3	126.2
25. Clasper length (adult only)	154.0	—		161.8	151.9~158.8	157.4
26. $\frac{\text{Eyeball length}}{\text{Interorbital length}}(\%)$	65.7	—		55.0	49.5~55.4	54.0
27. $\frac{\text{Eyeball length}}{\text{Preocular length}}(\%)$	33.3	—		22.2	19.0~23.7	21.9
28. $\frac{\text{Eyeball length}}{\text{Spiracle length}}(\%)$	94.8	—		72.4	69.4~77.8	72.4
In % of tail length						
29. Precaudal length	85.3	—		86.7	85.7~94.1	89.4
30. Length of electric organ**	—	—		—	37.0~41.8	40.7
31. D_1 origin to tail end	24.1	—		24.1	22.5~26.1	24.7
32. Post dorsal length	7.8	—		8.6	7.1~9.7	8.7
In % of cranium length**						
33. Cranium width	—	71.2		—	70.2~72.3	71.6
34. Rostral cartilage length	—	40.1		—	39.8~43.4	41.7
35. Prefontanelle length	36.3	36.6	36.5	—	36.1~39.1	37.7
36. Posterior fontanelle length	—	24.4		—	22.3~25.9	24.1
In % of clasper length						
37. Length of pseudosiphon	15.2	—		15.4	12.9~17.0	15.1
38. Posterior extremity of pseudosiphon to clasper tip	15.4	—		13.4	12.0~14.2	13.2

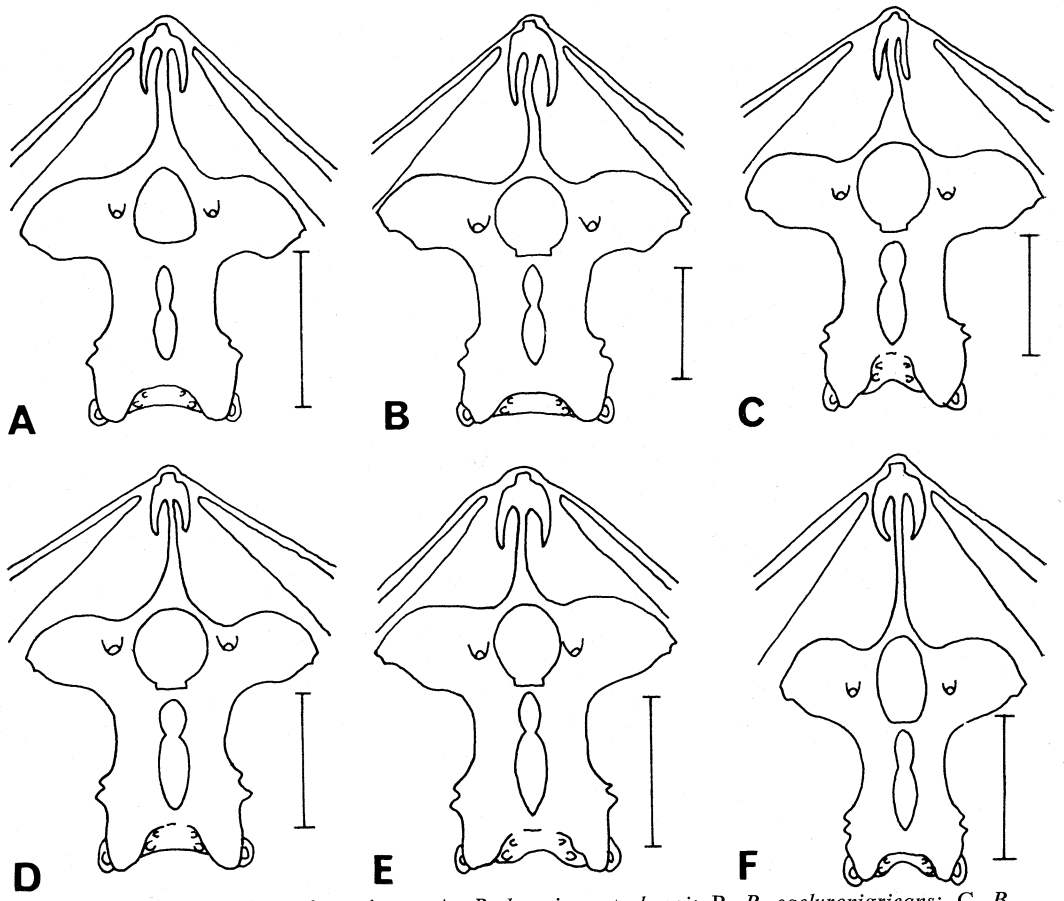

Fig. 7. Dorsal view of cranium. A, *Bathyraja matsubarai*; B, *B. caeluronigricans*; C, *B. notoroensis*; D, *B. maculata*; E. *B. lindbergi*; F, *B. minispinosa*. Scales indicate 50 mm.

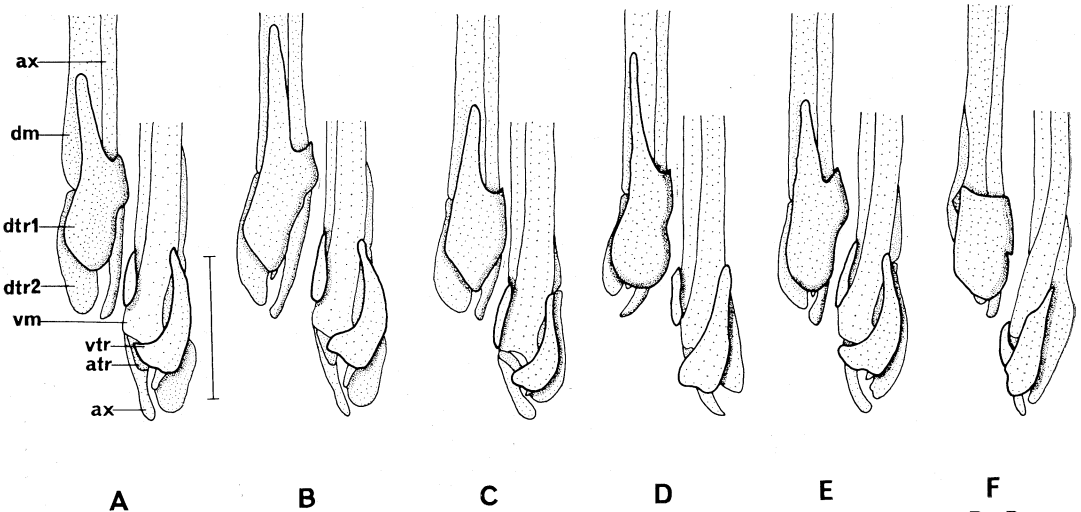

Fig. 8. Dorsal and ventral views of clasper cartilages. A, *Bathyraja matsubarai*; B, *B. caeluronigricans*; C, *B. notoroensis*; D, *B. maculata*; E, *B. lindbergi*; F, *B. minispinosa*. For each species, dorsal view is shown on top left, and ventral view on bottom right. atr, accessory terminal; ax, axial cartilage; dm, dorsal marginal; dtr 1, dorsal terminal **1**; dtr 2, dorsal terminal **2**; vm, ventral marginal; vtr, ventral terminal. Scale indicates 50 mm.

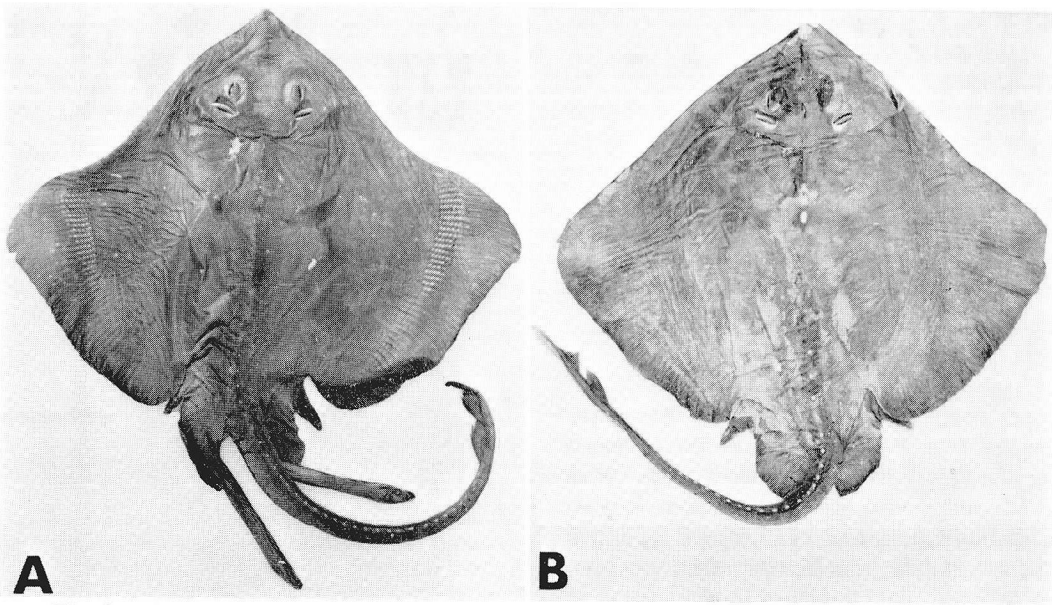

Fig. 9. *Bathyraja caeluronigricans* sp. nov. A, holotype, MTUF 21803, male, 744 mm in disk width; B, paratype, MTUF 21807, female, 700 mm in disk width.

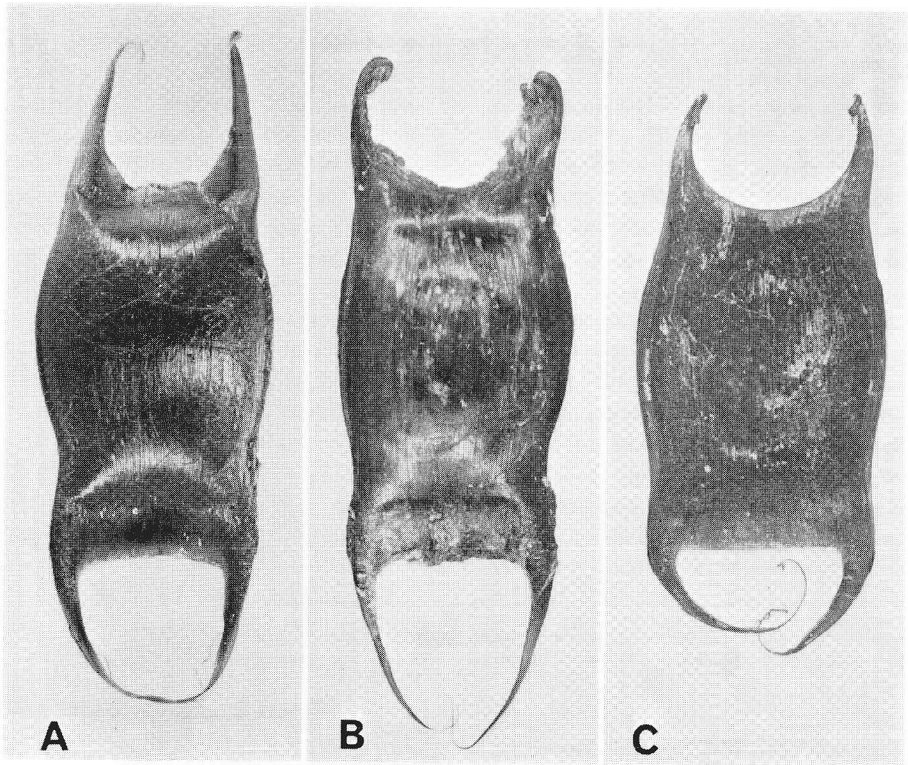

Fig. 10. Egg capsules. A, *Bathyraja caeluronigricans*; B, *B. maculata*; C, *B. minispinosa*. See Table 4 for the size of the capsules.

paratypes were captured with the holotype. The collecting locality is shown in Fig. 1.

Diagnosis. *Bathyraja caeluronigricans* differs from other species of the genus *Bathyraja* in the combination of dark purplish brown both sides of body, spiracle longer than eyeball and with deep concavity at their anterior part, deep cleft of clasper, and egg capsule densely covered with silky fibres.

Description. Meristic counts and morphometric measurements of the holotype and 13 paratypes are shown in Table 1.

External features: Snout short, soft and broad; eyeball less than spiracle; interorbital space flat and wide; spiracle large, deeply concave anteriorly. Two dorsals large, rather thick, equal in size, separated from each other by a short interspace. Tail longer than precaudal. Lateral folds developed on posterior half of tail. Dorsal side of disk rough with both large spines and minute prickles; scapular and interdorsal spines absent. A row of middorsal spines running from before scapular arch to first dorsal; the row interrupted at middle of trunk. Lumber spines, when present, followed by tail spines. Prickles developed on dorsal surface of disk, posterior pelvic lobes, and two dorsals and caudal, and absent in central part of pectorals, on tip of snout and anterior pelvic lobes. Ventral side of body smooth. Skin covering eyes without prickles.

Coloration: Ground color of dorsal side dark purplish brown, ventral side lighter. Areas in front of mouth, immediately before gill slits and around cloaca, distal portion of anterior pelvic lobes, and sensory pores whitish.

Internal features: Cranium wide; rostral cartilage short, soft, poorly calcified, slightly undulated; rostral appendix elongate, extending to middle of rostral cartilage. Anterior fontanelle spade-shaped, posterior margin flat, anterior margin extending to the line connecting front edge of nasal capsules; posterior fontanelle long, with a constriction in the middle (Fig. 7, B).

Clasper: Clasper long, extending to middle of tail, cylindrical, with a round tip, pseudosiphon large, located far from tip of clasper. Inner surface of dorsal lobe with a deep cleft and a pseudorhipidion. Posterior portion of inner surface of ventral lobe with a large projection and a small spur. Axial cartilage spatulated distally. Three dorsal terminals (**1**～**3**) more or less well developed. Dorsal terminal 1 elongate, pointed at anterior and posterior ends, middle portion swollen. Ventral terminal narrow anteriorly, gradually broadened toward posterior end, assuming the shape of the leaf of gingko. Accessory terminal small, firmly connected to posterior portion of ventral marginal (Fig. 8, B).

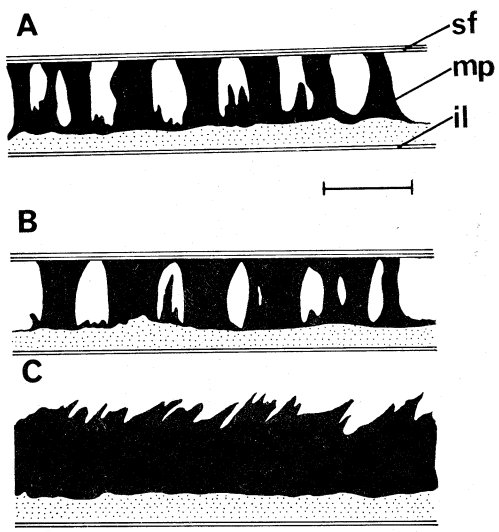

Fig. 11. Cross section (longitudinal) of the egg capsule. A, *Bathyraja caeluronigricans*; B, *B. maculata*; C, *B. minispinosa*. Outer surface up. il, inner layer; mp, minute prickle; sf, silky fibre. Scale indicates 2 mm.

Egg capsule: Measurements are shown in Table 4. Egg capsule large; each horn with a filamentous tip; long respiratory fissure present near middle of outer surface of each horn; posterior apron wider than anterior one; keel on lateral side quite narrow; bands of silky fibres covering main portion of capsule (Fig. 10, A). Surface rough with minute prickles in numerous longitudinal rows (Fig. 11, A). Coloration in fresh brilliant yellow-brown.

Etymology. The Latin adjective *caeluronigricans*, meaning purplish black, refers to the color of the dorsal side of the disk.

Bathyraja notoroensis sp. nov.
(New Japanese name: Notoro-kasube)
Figs. 12, A and B

Breviraja matsubarai Ishiyama, 1952: 10 (in

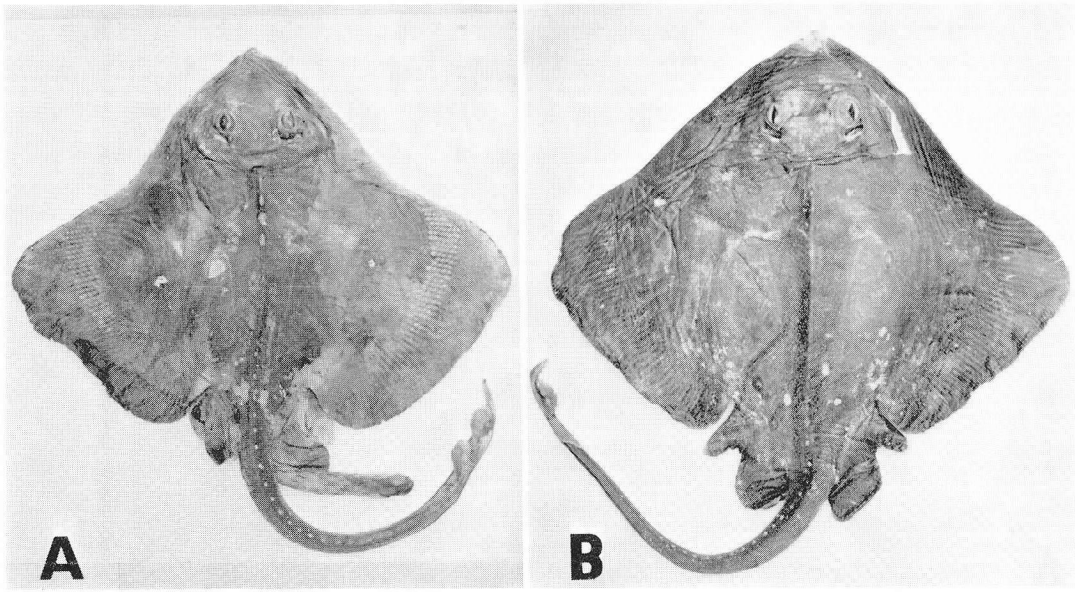

Fig. 12. *Bathyraja notoroensis* sp. nov. A, holotype, MTUF 21817, male, 582 mm in disk width; B, paratype, MTUF 21818, female, 590 mm in disk width.

part).

Holotype: MTUF 21817, adult male, 582 mm in disk width, collected off the Notoro Peninsula (44°00′N, 144°30′E), at a depth of about 600 m, on Oct. 2～3, 1971.

Paratypes: 4 adult males, MTUF 21819, 623 mm, captured with the holotype, HUMZ (Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University) 34830, 546 mm, HUMZ 34833, 570 mm, HUMZ 34870, 585 mm, all from the type locality, on Aug. 2, 1971; 1 adult female, MTUF 21818, 590 mm, captured with the holotype; 1 young male, FAKU 49459, 545 mm, Akkeshi Fish Market (43°00′N, 144°50′E), in 1938, designated as paratype of *B. matsubarai* by Ishiyama (1952) with Dr. Matsubara's Catalogue No. 5765. The collecting localities are given in Fig. 1.

Diagnosis. *Bathyraja notoroensis* differs from other species of the genus *Bathyraja* in the combination of dark greyish brown both sides of body, rather short clasper with a shallow cleft, and wide distance between extremity of pseudosiphon and tip of clasper.

Description. Meristic counts and morphometric measurements of the holotype and six paratypes are shown in Table 2.

External features: Snout short, soft and broad; interorbital space flat and wide. Two dorsals large, equal in size, separated from each other by a short interspace. Tail longer than precaudal. Lateral folds developed on posterior half of tail. Dorsal side of disk rough with both large spines and minute prickles; scapular and interdorsal spines absent. A row of mid-dorsal spines running from before scapular arch to first dorsal; the row interrupted at middle of trunk. Lumbar spines, when present, followed by tail spines. Prickles developed on whole dorsal surface of disk, and absent in central part of pectorals, on tip of snout and anterior pelvic lobes. Ventral side of body smooth. Skin covering eyes without prickles.

Coloration: Ground color of dorsal side dark greyish brown, ventral side lighter. Areas in front of mouth, immediately before gill slits, around cloaca, distal portion of anterior pelvic lobes, and sensory pores whitish.

Internal features: Cranium wide; rostral cartilage short, soft, poorly calcified, slightly undulated. Anterior fontanelle spade-shaped, anterior margin extending to the line connecting front edge of nasal capsules. Posterior fontanelle long with a constriction in the middle (Fig. 7, C).

Clasper: Clasper rather short, extending to

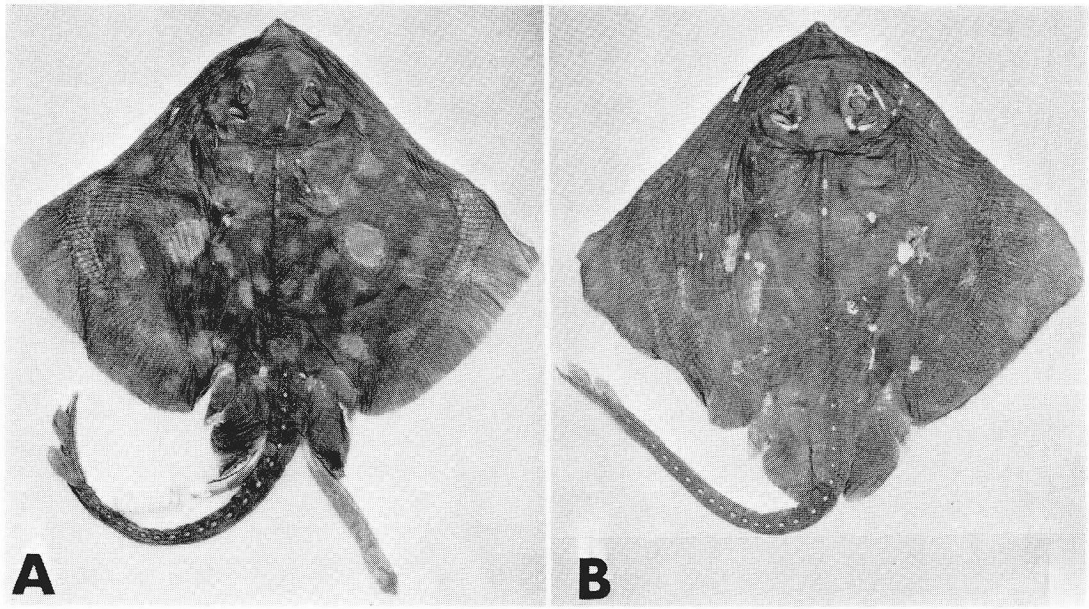

Fig. 13. *Bathyraja maculata* sp. nov. A, holotype, MTUF 21870, male, 644 mm in disk width; B, paratype, MTUF 21871, female, 700 mm in disk width.

middle of tail, with a round tip; pseudosiphon well developed, located far from tip of clasper. Inner surface of dorsal lobe with a shallow cleft and a pseudorhipidion. Posterior portion of inner surface of ventral lobe with a large projection and a small spur. Axial cartilage spatulated distally. Three dorsal terminals (**1**～**3**) more or less well developed. Dorsal terminal 1 elongate, pointed at anterior and posterior ends, middle portion swollen. Ventral terminal small, narrow anteriorly, broad posteriorly, assuming the shape of the leaf of gingko. Accessory terminal small, firmly connected to posterior edge of ventral marginal (Fig. 8, C).

Etymology. This species is named after the Notoro Peninsula, Hokkaido, where the holotype was collected.

Bathyraja maculata sp. nov.
(New Japanese name: Montsuki-kasube)
Figs. 13, A and B

Holotype: MTUF 21870, adult male, 644 mm in disk width, collected from the Bering Sea (59°10′N, 166°19′E), at a depth of about 450 m, on May 22, 1963.

Paratypes: 1 adult male, MTUF 21879, 617 mm, Bering Sea (61°07′N, 179°10′W), at a depth of about 245 m, on July 2～3, 1963; 3 adult females, MTUF 21871, 700 mm, MTUF 21880, 610 mm, MTUF 21881, 598 mm, Bering Sea (57°47′N～61°07′N, 174°33′E～173°47′W), at depths of about 245～570 m, from May 30 to July 2, 1963; 9 young males, MTUF 21883, 423 mm, MTUF 21884, 539 mm, MTUF 21885, 517 mm, MTUF 21886, 643 mm, MTUF 21887, 513 mm, MTUF 21888, 444 mm, MTUF 21889, 518 mm, MTUF 21890, 484 mm, MTUF 21891, 582 mm, Bering Sea (52°52′N～60°59′N, 160°06′E～179°00′W) at depths of about 190～450 m, from May 22 to July 12, 1963; 7 young females, MTUF 21892, 533 mm, MTUF 21893, 480 mm, MTUF 21894, 623 mm, MTUF 21895, 561 mm, MTUF 21896, 529 mm, MTUF 21897, 580 mm, MTUF 21898, 595 mm, Bering Sea (52°52′N～61°11′N, 160°06′E～173°47′W) at depths of about 190～570 m, from May 22 to July 12, 1963. The collecting localities are shown in Fig. 1.

Diagnosis. *Bathyraja maculata* differs from other species of the genus *Bathyraja* in the combination of white blotches of various sizes on dorsal side of disk, broad lateral folds of tail, clasper with a large pseudosiphon, and egg capsule densely covered with silky fibres.

Description. Meristic counts and morpho-

Table 2. Counts and measurements of *Bathyraja notoroensis* and *B. maculata*. As for characters and legend, see Table 1.

Characters	*B. notoroensis*			*B. maculata*		
	Holotype	Paratypes N=6(♂4, ♀1, young 1)	Mean N=7	Holotype	Paratypes N=20(♂1, ♀3, young 16)	Mean N=21
1.	898	896~1037	936.5	950	908~1077	962.0
2.	582	570~623	582.7	644	598~700	633.8
3.	145	150~168	156.8	160	157~177	161.8
4.	476	455~530	483.3	489	467~544	496.6
5.	35	34~36	34.8	33	31~35	32.6
6.	72	68~76	71.8	68	67~75	71.3
7.	121	116~122	119.5	114	111~121	116.5
8.	3	2~5	3.8	3	2~5	3.4
9.	1	0~2	1.0	0	0~3	0.2
10.	27	24~28	25.8	21	18~26	22.1
11.	25	20~21	22.5	20.5	21	20.8
12.	7	4~7	6.3	5	6	5.5
13.	11	9~10	10.0	—	10~11	10.4
14.	23	18~30	23.0	23	22~34	27.8
15.	13	14~16	14.7	18	15~19	17.0
16.	154.3	154.2~166.5	160.7	147.5	150.1~153.9	151.3
17.	78.0	77.8~82.1	79.6	76.9	76.4~78.8	77.3
18.	81.8	77.8~85.3	83.0	75.9	75.7~80.3	77.6
19.	57.9	60.5~62.5	61.0	61.3	59.3~64.6	61.6
20.	31.4	25.0~28.5	27.3	30.0	23.2~27.2	26.5
21.	17.9	14.9~17.4	16.5	18.8	16.9~19.6	18.2
22.	18.6	17.1~19.5	18.3	18.1	16.6~19.5	17.7
23.	120.0	106.8~120.7	115.0	123.1	121.5	122.3
24.	—	128.3		—	120.4~128.0	124.9
25.	150.3	134.6~148.1	143.0	165.0	166.5	165.8
26.	57.1	57.6~66.7	62.8	62.5	64.1~75.3	69.6
27.	31.0	24.1~28.8	27.1	30.6	26.7~34.6	30.1
28.	96.3	83.3~96.6	90.4	103.4	95.2~112.0	103.5
29.	89.7	89.4~98.0	93.7	93.7	92.2~98.9	95.0
30.	—	32.3~42.2	38.5	—	36.2~39.8	38.1
31.	27.5	24.3~35.5	27.8	24.7	22.1~27.0	24.8
32.	10.4	6.0~9.7	8.6	6.6	4.9~8.7	6.7
33.	75.2	74.7~79.0	76.3	—	69.1~75.8	72.2
34.	36.9	39.5~41.3	39.2	—	37.8~39.8	38.8
35.	32.9	34.3~35.9	34.4	—	32.1~35.7	34.1
36.	22.1	21.4~24.4	22.6	—	26.9~28.7	27.5
37.	12.6	11.6~15.4	13.3	20.8	18.4	19.6
38.	17.9	15.0~17.1	16.6	12.1	14.1	13.1

metric measurements of the holotype and 20 paratypes are shown in Table 2.

External features: Snout short, soft and broad; interorbital space flat and wide. Two dorsals large, equal in size, separated from each other by a short interspace. Tail longer than precaudal. Lateral folds broad (breadth at second dorsal origin ca. 7 mm), developed on posterior half of tail. Dorsal side of disk rough with both large spines and prickles; scapular and interdorsal spines absent. A row of mid-dorsal spines running from before scapular arch to first dorsal; the row interrupted at middle of trunk. Lumbar spines, when present, followed by tail spines. Prickle developed on dorsal surface of disk, posterior pelvic lobes, two dorsals and caudal, and absent in central part of pectorals, on tip of snout and anterior pelvic lobes. Ventral side of body smooth. Skin covering eyes without prickles.

Coloration: Ground color of dorsal side dark greyish brown, ventral side whitish. Tail dark greyish brown on both sides. Whole of dorsal side of disk mottled with many white blotches of various sizes; whole of ventral side with darkish blotches. Areas around cloaca, posterolateral side of pectoral fins, and posterior pelvic lobes somewhat dark brown.

Internal features: Cranium wide; rostral cartilage short, poorly calcified, slightly undulated. Anterior fontanelle spade-shaped, anterior margin extending to the line connecting front edge of nasal capsules; posterior fontanelle long, with a constriction in the middle (Fig. 7, D).

Clasper: Clasper long, extending to middle of tail, cylindrical, with a round tip; pseudosiphon large, located far from tip of clasper. Inner surface of dorsal lobe with a shallow cleft and a pseudorhipidion. Posterior portion of inner surface of ventral lobe with a large projection and a small spur. Axial cartilage spatulated distally. Three dorsal terminals (**1**～**3**) more or less well developed. Dorsal terminal 1 elongate, pointed anteriorly and blunt posteriorly, and swollen at middle portion. Ventral terminal narrow anteriorly and gradually broadened toward posterior end, like the leaf of gingko. Accessory terminal small, firmly connected to posterior edge of ventral marginal (Fig. 8, D).

Egg capsule: Measurements are shown in Table 4. Egg capsule large; each horn with a filamentous tip; long respiratory fissure present near middle of outer surface of each horn. Posterior apron wider than anterior one; keel on lateral side quite narrow; bands of silky fibres densely covering main portion of capsule (Fig. 10, B). Surface rough with minute prickles in numerous longitudinal rows (Fig. 11, B).

Etymology. The Latin adjective *maculata*, meaning blotched, refers to the color markings on the dorsal side of the disk.

Bathyraja lindbergi sp. nov.
(New Japanese name: Komandoru-kasube)
Figs. 14, A and B

Holotype: MTUF 21820, adult male; 551 mm in disk width, collected from the Bering Sea (57°47′N, 173°47′W), at a depth of about 570 m, on June 12, 1963.

Paratypes: 5 adult males, MTUF 21825, 524 mm, MTUF 21826, 520 mm, MTUF 21827, 498 mm, MTUF 21828, 491 mm, MTUF 21831, 607 mm, Bering Sea (52°52′N～57°15′N, 160°06′E～163°17′E), at depths of about 160～200 m, on July 10～12, 1963; 5 adult females, MTUF 21821, 532 mm, MTUF 21822, 515 mm, MTUF 21823, 514 mm, MTUF 21824, 502 mm, MTUF 21830, 493 mm, Bering Sea (54°26′N～57°15′N, 163°17′E～166°22′W) at depths of about 160～500 m, from June 20 to July 10, 1963; 1 young male, MTUF 21829, 477 mm, Bering Sea (57°15′N, 163°17′E) at a depth of about 160 m, on July 10, 1963. The collecting localities are plotted in Fig. 1.

Diagnosis. *Bathyraja lindbergi* differs from other species of the genus *Bathyraja* in the combination of coloration with whitish brown ventral surface of disk in contrast with dark greyish brown on other parts, no scapular spine, and uninterrupted row of middorsal spines running from before scapular arch to first dorsal.

Description. Meristic counts and morphometric measurements of the holotype and 11 paratypes are shown in Table 3.

External features: Snout soft, short and broad; interorbital space flat and wide. Two dorsals large, equal in size, separated from

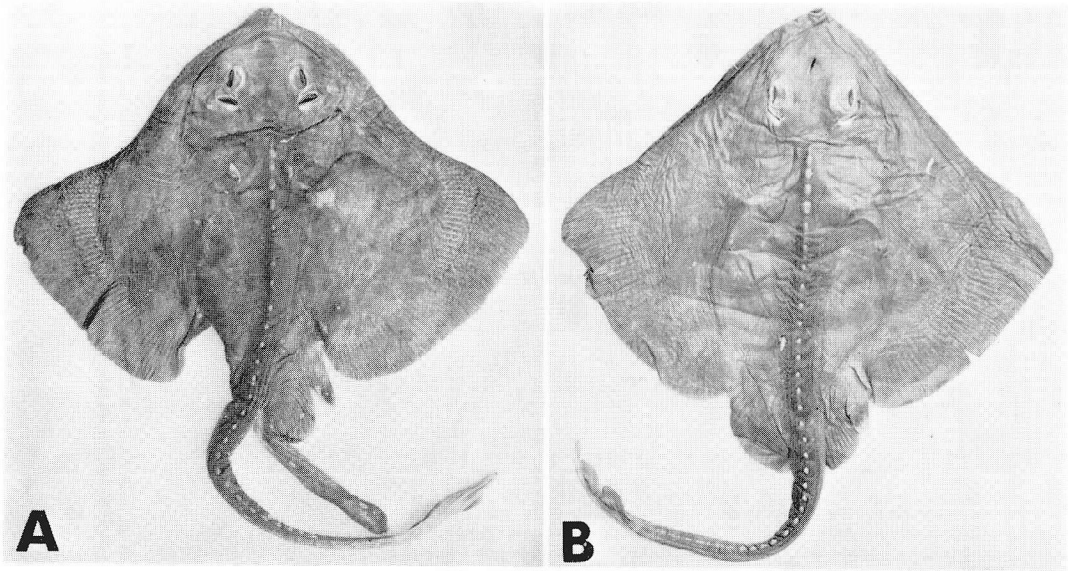

Fig. 14. *Bathyraja lindbergi* sp. nov. A, holotype, MTUF 21820, male, 551 mm in disk width; B, paratype, MTUF 21823, female, 514 mm in disk width.

each other by a short interspace. Tail longer than precaudal. Lateral folds developed on posterior half of tail. Dorsal side of disk rough with both large spines and minute prickles; scapular and interdorsal spines absent. A median dorsal row of large spines running continuously from before scapular arch to first dorsal. Prickles developed on dorsal surface of disk, and absent in central part of pectorals, and on tip of snout and anterior pelvic lobes. Ventral side of body smooth. Skin covering eyes without prickles.

Coloration: Ground color of dorsal side dark greyish brown, ventral surface mostly whitish brown. Tail dark greyish brown on both sides. Areas around mouth, cloaca and immediately before gill slits, and distal portion of anterior pelvic lobes whitish. Sensory pores not distinguishable from the ground color. In the specimen MTUF 21831, dorsal side of disk with many white mottles.

Internal features: Cranium wide, rostral cartilage short, poorly calcified, slightly undulated. Anterior fontanelle spade-shaped; anterior margin extending to the line connecting front edge of nasal capsules; posterior fontanelle long (Fig. 7, E).

Clasper: Clasper long, extending to middle of tail, cylindrical, with a round tip; pseudosiphon well developed, located far from tip of clasper. Inner surface of dorsal lobe with a shallow cleft and a pseudorhipidion. Posterior portion of inner surface of ventral lobe with a large projection and a small spur. Axial cartilage spatulated distally. Three dorsal terminals (**1**～**3**) more or less well developed. Dorsal terminal 1 elongate, pointed anteriorly and blunt posteriorly, middle portion swollen. Ventral terminal narrow anteriorly and gradually broadened toward posterior end, assuming the shape of the leaf of gingko. Accessory terminal small, firmly connected to posterior edge of ventral marginal (Fig. 8, E).

Etymology. This species is named after the late Dr. G. U. Lindberg for his great work on western North Pacific zoogeography.

Bathyraja minispinosa sp. nov.

(New Japanese name: Subesube-kasube)

Figs. 15, A and B

Holotype: MTUF 21872, adult male, 515 mm in disk width, collected from the Bering Sea (59°10′N, 166°19′E), at a depth of about 450 m, on May 22, 1963.

Paratypes: 5 adult males, MTUF 21899, 466 mm, MTUF 21900, 524 mm, MTUF 21901, 508 mm, MTUF 21902, 527 mm, MTUF 21903,

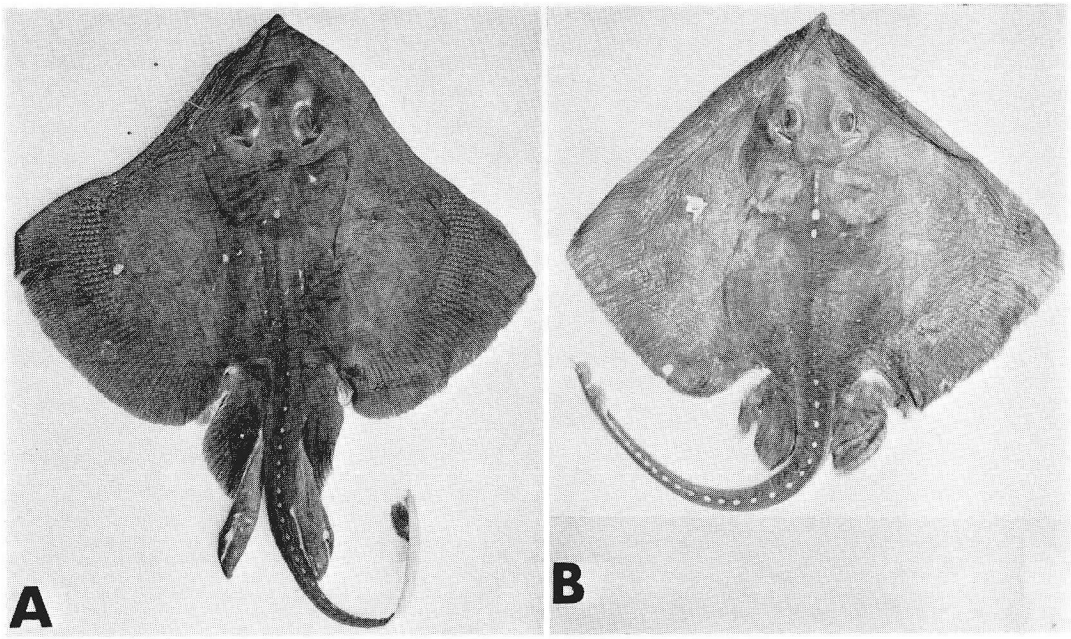

Fig. 15. *Bathyraja minispinosa* sp. nov. A, holotype, MTUF 21872, male, 515 mm in disk width; B, paratype, MTUF 21873, female, 479 mm in disk width.

472 mm, Bering Sea (52°46′N～60°59′N, 159°28′E～174°33′E), at depths of about 400～450 m, on May 17～30, 1963; 8 adult females, MTUF 21873, 479 mm, MTUF 21904, 488 mm, Bering Sea (58°30′N, 175°10′W), at a depth of about 300 m, on Oct. 20, 1962, MTUF 21905, 439 mm, MTUF 21906, 493 mm, MTUF 21907, 474 mm, MTUF 21908, 422 mm, MTUF 21909, 465 mm, MTUF 21910, 479 mm, Bering Sea (52°46′N～60°59′N, 159°28′E～166°22′W), at depths of about 160～530 m, from May 17 to July 10, 1963. The collecting localities are shown in Fig. 1.

Diagnosis. *Bathyraja minispinosa* differs from other species of the genus *Bathyraja* in the combination of whitish area along inner margin of eyes, minute fine prickles on dorsal side of disk, pointed clasper with a pseudo-siphon-like groove, and smaller egg capsule densely covered with minute prickles.

Description. Meristic counts and morphometric measurements of the holotype and 13 paratypes are shown in Table 3.

External features: Snout long, soft and pointed; interorbital space narrow and somewhat concave. Two dorsals equal and moderate in size, separated from each other by an interspace. Tail generally longer than precaudal. Lateral folds developed on posterior half of tail. Distance between first gill slits as long as head and 1.5 times preoral length. Dorsal side of disk with large spines. Scapular, lumbar and interdorsal spines absent. A row of mid-dorsal spines running from before scapular arch to first dorsal; the row interrupted at middle of trunk. Minute, very fine prickles smooth to the touch covering on dorsal side of disk, posterior pelvic lobes, two dorsals and caudal; central part of pectorals and anterior pelvic lobes devoid of prickles. Skin covering eyes and ventral side of tip of snout sometimes with prickles. Ventral side of body except tip of snout with smooth surface.

Coloration: Ground color of dorsal side dark brown excepting whitish area along inner margin of eyes in case of male markably. Ventral side largely brown. Areas around mouth and cloaca, immediately before gill slits, and ventral surface of clasper whitish.

Internal features: Cranium rather narrow; rostral cartilage long, soft and poorly calcified; anterior fontanelle long, oval-shaped, posterior margin flat, anterior margin extending beyond

Table 3. Counts and measurements of *Bathyraja lindbergi* and *B. minispinosa*. As for characters and legend, see Table 1.

Characters	*B. lindbergi*			*B. minispinosa*		
	Holotype	Paratypes N=11 (♂5, ♀5, young 1)	Mean N=12	Holotype	Paratypes N=13 (♂5, ♀8)	Mean N=14
1.	874	768～876	817.0	768	663～790	718.1
2.	551	491～607	522.5	515	439～527	483.6
3.	134	131～153	139.5	151	132～154	144.3
4.	482	391～488	446.5	404	338～435	372.7
5.	31	29～34	32.0	32	29～34	31.8
6.	71	68～72	69.2	71	65～76	69.9
7.	114	113～117	114.6	114	108～119	113.4
8.	4	3～5	3.8	2	1～4	2.4
9.	5	4～6	5.3	0	0	0
10.	25	20～28	23.8	24	19～26	21.9
11.	21.5	19～22	20.2	22.5	21～23	21.8
12.	6	4～7	5.7	6	5～7	5.6
13.	11	10～11	10.8	—	8～9	8.8
14.	27	21～29	25.3	31	28～34	32.1
15.	17.5	15～17.5	15.9	16.5	12～17	14.9
16.	158.6	144.3～160.7	156.5	149.1	140.9～154.4	148.5
17.	76.8	74.9～81.0	79.0	78.6	74.8～81.0	78.5
18.	87.5	79.3～88.0	83.7	78.4	71.3～83.0	77.0
19.	59.7	58.8～64.9	62.2	66.2	63.2～69.6	66.9
20.	29.1	23.5～27.0	26.1	18.5	15.6～20.5	18.5
21.	22.4	16.5～20.7	18.3	17.2	14.8～18.5	16.7
22.	22.4	17.3～21.4	19.9	16.6	13.4～17.8	15.8
23.	131.3	118.3～133.3	126.9	92.7	97.4～105.5	99.0
24.	—	119.0～133.6	126.3	—	92.2～103.5	98.6
25.	177.6	162.6～181.1	170.3	116.6	122.7～131.6	127.1
26.	76.9	67.5～82.4	72.0	92.9	80.0～104.0	90.8
27.	37.5	27.1～32.9	30.2	26.0	21.4～28.4	25.0
28.	100.0	83.3～113.8	95.1	104.0	88.9～125.0	106.7
29.	81.5	79.1～98.7	88.3	91.1	82.8～107.2	93.8
30.	—	35.5～41.7	39.5	—	—	
31.	24.9	21.4～26.8	24.9	22.0	17.8～27.0	23.5
32.	7.9	6.6～9.7	7.9	5.9	3.8～9.0	7.1
33.	72.1	74.2～77.7	74.7	—	53.3～57.7	55.8
34.	35.3	35.8～36.7	35.9	—	44.3～48.7	46.5
35.	33.4	31.8～34.8	33.3	—	40.2～44.3	41.6
36.	30.4	27.0～30.3	29.2	—	20.3～23.2	22.0
37.	16.2	13.8～16.4	15.5	—	—	
38.	14.5	13.6～15.7	14.5	—	—	

Table 4. Measurements (mm) of egg capsule of three species of *Bathyraja*.

Character	*B. caeluronigricans*	*B. maculata*	*B. minispinosa*
Length (without horns)	104	97	76
Width (minimum～maximum)	52～65	51～63	46～56
Horn length: anterior	55	65	40
Horn length: posterior	105	100	75
Keel width: lateral	3	4	4
Anterior apron width	8	11	3
Posterior apron width	15	17	14

the line connecting front edge of nasal capsules; posterior fontanelle as long as anterior one, with a constriction in the middle (Fig. 7, F).

Clasper: Clasper specifically spatulated pointed distally and not reaching middle of tail; pseudosiphon far from tip of clasper and located near outer margin of dorsal lobe. A pseudosiphon-like groove present near tip of clasper on opposite margin of dorsal lobe. Inner surface of dorsal lobe with a shallow cleft and a pseudorhipidion. Posterior portion of inner surface of ventral lobe with a small spur; projection absent. Axial cartilage spatulated distally. Three dorsal terminals (**1**～**3**) more or less well developed. Dorsal terminal 1 broad, rectangular in shape and pointed distally. Outer margin of dorsal marginal recurved upward, followed by dorsal terminal 2 at posterior end. Ventral terminal long, leaf-like, pointed anteriorly and blunt distally. Accessory terminal long, extending near tip of clasper (Fig. 8, F).

Egg capsule: Measurements are shown in Table 4. Egg capsule smaller; long respiratory fissure present near middle of outer surface of each horn. Posterior apron wider than anterior one; silky fibres poorly developed (Fig. 10, C). Surface rough, densely covered with minute prickles in numerous longitudinal rows (Fig. 11, C).

Etymology. The Latin adjective *minispinosa*, meaning full of small thorns, refers to the dorsal side of the disk covered with many minute fine prickles, which are smooth to the touch.

Interspecific relationships

As regards to the presence or absence of the scapular spines and mid-dorsal disk spines, the five new species and *B. matsubarai* show close affinities with one another, but are distinguished from other 10 western North Pacific species (Table 5).

Among the six species described above, *B. minispinosa* from the Bering Sea is quite distinctive in the possession of the clasper with a pseudosiphon-like groove, which is a unique character among all members of the genus *Bathyraja*. Moreover, this species is separable from other five species by its pointed claspers.

Other five species presently described, i.e., *B. matsubarai*, *B. caeluronigricans*, *B. notoroensis*, *B. maculata*, and *B. lindbergi*, are similar in having a short snout, a broad cranium, claspers with a long pseudosiphon located far from the tip of the clasper in relation to the long dorsal terminal **1**. Egg capsules of two species, *B. caeluronigricans* and *B. maculata*, have in common silky fibres covering the whole surface. Although we have not examined egg capsules of the other three species, they may have characters similar to those of the two species described above.

While many of the meristic and morphometric characters show overlaps to some extent in these five sepcies, they show trends towards increase in the following ways (CAE: *B. caeluronigricans*, LIN: *B. lindbergi*, MAC: *B. maculata*, MAT: *B. matsubarai*, NOT: *B. notoroensis*): number of precaudal vertebrae, LIN·MAC→CAE·MAT·NOT; eyeball length/head length, LIN·MAC·MAT→NOT→CAE; eyeball length/interorbital length, LIN·MAC→MAT·NOT→CAE; posterior fontanelle length/cranium length, CAE·MAT·NOT→LIN·MAC (Tables 1～3). These characters are seemingly associated with the geographic distribution of the five species.

The morphological similarities and the interspecific variations associated with geographic distribution strongly suggest the common phylogenetic origin of the two Bering and the three northern Japanese species and their dispersal from a common center of distribution.

Of these five monophyletic species, the Bering *B. maculata* and *B. lindbergi* share in common the dorsal terminal **1** with a round posterior margin, a longer posterior fontanelle (Tables 1～3) and coloration with whitish ventral surface of the disk. On the other hand, the three northern Japanese species differ from the two Bering species in the following points; the posterior margin of the dorsal terminal **1** is pointed, the posterior fontanelle is shorter (Tables 1～3) and the ventral side of the disk is dark brown. It is evident from the above that this monophyletic group consists of two geographic subgroups.

Difference between *B. maculata* and *B. lindbergi* from the Bering Sea lies in the continuity of the row of mid-dorsal spines and the length of the pseudosiphon of the clasper. It is possible that the longer pseudosiphon in *B. maculata* enables the clasper to open more widely than in *B. lindbergi*, and the structure of the glans has caused the reproductive isolation of the two species. These two species can be regarded as sympatric sister species.

The sympatric Bering *B. parmifera* (Bean, 1881) and *B. smirnovi* (Soldatov and Pavlenko, 1915) appear to exemplify the same mechanism of isolation caused by the difference in the structure of the claspers. It is interesting that in this pair of sister species the continuity of the row of mid-dorsal spines is associated with specific separation, the row being continuous in *B. parmifera* and interrupted in *B. smirnovi*.

Incorporating all the evidences now available, the course of the speciation of the six species may be postulated as follows: from an ancestral stock common to other species of *Bathyraja* two off-shoots have arisen. One has evolved to the Bering *B. minispinosa*, which has undergone a conspicuous specialization in the structure of the claspers. The other has dispersed in the Bering Sea and around northern Japan, and given rise to two species in the former region and three in the

Table 5. Comparison of characters in 16 species of *Bathyraja* under study. Data presented are all from specimens dealt with in this study. As for the method of vertebral counts, see Table 1. *, *Bathyraja simoterus* from Ishiyama (1967); **, obscure species; ***, 3 specimens and 2 radiographs; +, present; ± not constantly present; −, absent; cont, continuous; int, interrupted; irr, irregularly arranged.

Characters	N	Mid-dorsal disk spines	Mid-dorsal tail spines	Scapular spines	Interdorsal spines	Pseudosiphon	Pseudosiphon −like groove	Blotches on disk	Precaudal vertebrae	Caudal vertebrae	Total vertebrae
parmifera	41	cont.	cont.	+	+	+	−	±	37～43	76～87	134～144
*simoterus**	0	cont.	cont.	+	+	+	−	−	−	−	−
aleutica	32	cont.	cont.	+	+	+	−	−	35～38	69～77	120～125
smirnovi	21	int.	cont.	+	+	+	−	±	35～43	76～91	128～142
isotrachys	1	int.	cont.	+	+	+	−	−	39	87	139
trachouros	2	absent	cont.	+	−	−	−	−	36	78	125
*interrupta***	23	int.	cont.	+	+	−	−	−	29～35	60～73	103～117
lindbergi	12	cont.	cont.	−	−	+	−	±	29～34	68～72	113～117
maculata	21	int.	cont.	−	−	+	−	+	31～34	67～74	113～121
notoroensis	7	int.	cont.	−	−	+	−	−	35～36	68～76	116～122
caeluronigricans	14	int.	cont.	−	−	+	−	−	36～38	69～75	119～124
matsubarai	2	int.	cont.	−	−	+	−	−	36～38	72	120
minispinosa	14	int.	cont.	−	−	+	+	−	29～34	65～76	108～119
diplotaenia	1	absent	cont.	−	−	+	−	−	33	71	117
violacea	5***	absent	irr.	−	−	−	−	+	33～37	66～73	110～118
tobitukai	2	absent	absent	−	−	−	−	−	27～28	64～67	101～104

latter.

The morphological separation in internal characters may indicate the long geographic isolation of the two subgroups. Differences in internal characters have not been found among species in each of the two subgroups. This fact may reflect the comparatively short histories of speciation within each subgroup.

Comparative materials

Bathyraja parmifera (Bean, 1881). 10 adult males, MTUF 21911～MTUF 21920, 646～689 mm, Bering Sea, 1962～1963; 6 adult females, MTUF 21921～MTUF 21926, 617～712 mm, Bering Sea, 1962～1963; 15 young males, MTUF 21936～MTUF 21950, 252～615 mm, Bering Sea, 1963; 10 young females, MTUF 21951～MTUF 21959, MTUF 21967, 317～550 mm, Bering Sea, 1963.

Bathyraja aleutica (Gilbert, 1895). 3 adult males, MTUF 21973～MTUF 21975, 680～766 mm, Bering Sea, 1963; 3 adult females, MTUF 21976～MTUF 21978, 684～756 mm, Bering Sea, 1963; 13 young males, MTUF 21979～MTUF 21991, 399～712 mm, Bering Sea, 1962～1963; 13 young females, MTUF 21992～MTUF 22004, 420～606 mm, Bering Sea, 1962～1963.

Bathyraja smirnovi (Soldatov and Pavlenko, 1915). 5 adult males, MTUF 21927～MTUF 21931, 720～787 mm, Bering Sea, 1963; 4 adult females, MTUF 21932～MTUF 21935, 709～783 mm, Bering Sea, 1963; 7 young males, MTUF 21960～MTUF 21966, 478～695 mm, Bering Sea, 1963; 5 young females, MTUF 21968～MTUF 21972, 474～603 mm, Bering Sea, 1963.

Bathyraja isotrachys (Günther, 1887). 1 young male, FAKU 49460, 437 mm, no data.

Bathyraja trachouros (Ishiyama, 1958). 2 adult males, FAKU 49464 (holotype, Ishiyama's Fish Collection No. 16736), 580 mm, off Erimo Peninsula, Hokkaido, May 19, 1951, MTUF 22005, 511 mm, Hachinohe, 1962.

? *Bathyraja interrupta* (Gill and Townsend, 1897). 8 adult males, MTUF 22006～MTUF 22013, 424～502 mm, Bering Sea, 1962～1963; 9 adult females, MTUF 22014～MTUF 22022, 445～535 mm, Bering Sea, 1962～1963; 4 young males, MTUF 22023～MTUF 22026, 418～454 mm, Bering Sea, 1963; 2 young females, MTUF 22027～MTUF 22028, 375～411 mm, Bering Sea, 1963.

Bathyraja diplotaenia (Ishiyama, 1952). 1 adult male, FAKU 49463 (holotype, Ishiyama's Fish Collection No. 10886), 576 mm, off Erimo Peninsula, Hokkaido, Oct. 18, 1948.

Bathyraja violacea (Suvorov, 1935). 2 adult males, MTUF 22029, 420 mm, Bering Sea, 1962, MTUF 22030, 420 mm, off Abashiri, Oct. 2, 1971; 1 adult female, MTUF 22032, 458 mm, collected with MTUF 22030; 2 young males, ZIAS (Zoological Institute, Academy of Science, U.S.S.R.) 25073 (holotypes), western Kamchatka, July, 1933, only radiographs were examined.

Bathyraja tobitukai (Hiyama, 1940). 2 adult females, MTUF 21868～MTUF 21869, 244～256 mm, Kumano-nada, Mie Prefecture, date unknown.

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北西太平洋から得られたガンギエイ5新種とその類縁関係

石山 礼蔵・石原 元

水産庁ならびに東京水産大学の採集により得られた北西太平洋のソコガンギエイ類 (*Bathyraja*) の標本から，1) 体各部の相対長，2) 計数的諸形質，3) 斑紋の有無，4) 体背面に分布する大小の棘の有無，5) 軟骨性頭蓋の構造，6) 交接器の構造，7) 卵殻の構造などの組合せで，この海域に分布する既知 11 種のソコガンギエイとは異なる5種が区別された．

上記5種はそれぞれ新種として，噴水孔前縁が深く

くぼむツムラカスベ *Bathyraja caeluronigricans*, やや小さい交接器を持つノトロカスベ *B. notoroensis*, 体背面に白色斑のあるモンツキカスベ *B. maculata*, 体背面の肥大棘が連続して並ぶコマンドルカスベ *B. lindbergi*, 体背面の小棘がまばらなスベスベカスベ *B. minispinosa* と命名した.

石山が 1952 年に発表したマツバラエイ *B. matsubarai* は前 4 種と諸形質が類似し, 殊にこの種の副模式標本は本研究でノトロカスベと同定されたため, 新種 5 種の記載と共にマツバラエイを再記載し, 6 種の類縁関係を動物地理学的に考察した.

(石山: 359 埼玉県所沢市山口 1814; 石原: 108 東京都港区港南 4-5-7　東京水産大学魚類学講座)